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APPLICATION

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Room Constructing

TECHNICAL FIELD

This invention relates to pre-manufactured concrete building structures, and more particularly, to building structures which can be attached to and removed from existing structures for repeated use.

BACKGROUND

For background, reference is made to United States Patent Numbers 4,171,596, 4,275,533, 4,573,292, 4,745,719, 5,265,384, 5,727,353, 5,845,441, and 6,330,771.

SUMMARY

There is a need to provide portable structures to function as school classrooms, office spaces, and/or apartments in a economical and expeditious way. Readily adaptable and configurable building facilities are required to meet the rapidly changing requirements for facilities such as school classrooms. Structures according to the invention are formed from pre-manufactured modules which can be joined in many configurations for serving temporary or long term building needs.

Structures according to the invention can be readily attached to an existing building or serve as a standalone structure. In addition, the structure can be used for a number of years after being delivered to the site. If and when the demographics again change and the additional space afforded by the structure is no longer needed, the structure can be detached and moved to a new site for expansion of a new school facility.

Specifically in school applications, the total lead time from planning through commissioning, to building operation can take more than six years. With typical school expansion projects, an architectural firm will spend substantial efforts to develop and plan structures fitting the classrooms to the particular needs of the school. However, when specifying building modules according to the invention, the time required to plan and build the additional space is minimized. The necessity for numerous site specific shop drawings is also reduced because the specifications of the structure according to the invention are predefined. Through

application of structures according to the invention, the delivery time and the costs of construction can be greatly reduced. Architects, engineers and school officials know building dimensions, specifications and costs in advance. Therefore, site specific planning and variability is vastly reduced. The total construction time is reduced because precasting of the building modules can be done concurrent with preparation of the existing school facility and adjacent construction site.

In one aspect according to the invention, a building structure includes at least one building module for providing a temporary or permanent dwelling space, the module including wall, floor and ceiling members formed from reinforced precast concrete. The members are detachably coupled to one another to form an enclosed space, with adjacent members being spaced apart from each other a predetermined distance. A compliant pad spans this distance and couples adjacent members to accommodate relative movement between the members during transport and once the structure is located on the site.

In one embodiment, the compliant pad is a synthetic rubber. In another embodiment, the structure includes a concrete form attached to the ceiling to accommodate fixtures, electrical conduit or suspending ceiling materials. The concrete form can include a channeled layer, such as a composite floor deck ceiling system, including EPICORE® (Epic Metals Corporation, Rankin, Pennsylvania), for example. In another embodiment, the members of the structure are further adapted to detachably engage a second additional building module, comparable to the first module, to form a single larger structure. The modules can be arranged vertically to form a multiple-story building or connected along a horizontal orientation to form a larger single-story structure.

The structure can also include a conduit extending through the members for accommodating building utilities including at least one of plumbing, electrical, heating, ventilating, and air conditioning. The structure can also be adapted for attachment to an preexisting structure. The structure can also include any of number of exterior facade surfaces, such as brick, stone, stucco, or any combination thereof.

According to another aspect, of the invention, a portable pre-manufactured building includes a generally parallelepipal structure for releasable attachment to a pre-existing structure having vertical walls, a horizontal floor, and a horizontal ceiling. The walls and ceilings are formed from cast concrete including reinforcing steel rebar and include a connecting layer disposed between the top of the walls and the ceilings. Wall members can also include at least one conduit for uninterrupted passage of utilities.

In a various embodiments, the connecting substrate is a synthetic rubber, such as neoprene, for example. A channeled layer, such as EPICORE® or equivalent, can be attached to the floor and ceiling members. The members of the structure can be further adapted to detachably engage a second additional structure, comparable to the first structure, to form a single larger structure. The structure can also include a conduit extending through the wall members for accommodating building utilities, including, for example, at least one of plumbing, electrical, heating, ventilating, and air conditioning.

The details of one or more embodiments of the invention are set forth in the accompanying drawings and the description below. Other features, objects, and advantages will be apparent from the detailed description, which refers to the following drawings, in which:

DESCRIPTION OF DRAWINGS

FIG. 1 is a perspective view of a pre-manufactured concrete building module according to the invention;

FIG. 2 is a perspective view of two of the building modules shown in FIG. 1, arranged in a vertical configuration;

FIG. 3 is a floor plan view of a pre-manufactured concrete building module attached to an existing building;

FIG. 4 is a section view of the building module of FIG. 3 through line A-A;

FIG. 5 is a floor plan view of the structure of FIG. 1;

FIG. 6 is a cross-section elevation view of the typical wall and foundation construction;

FIG. 7 is a cross-section elevation view of wall, floor, and foundation construction;

FIG. 8 is a detail cross-section view of the junction between ceiling and wall members and floor and ceiling members;

FIG. 9 is another detail cross-section view of the junction between ceiling and wall members and floor and ceiling members;

FIG. 10 is a detail cross-section view of the junction between floor, ceiling, and wall members which depicts the attachment to the building foundation;

FIG. 11 is a detail cross-section view of a junction between adjacent floor members and a wall member;

FIG. 12 is a detail cross-section view of a window installed in a wall member; and

FIG. 13 is a detail view of an exterior door and an attached folding stair.

Like reference symbols in the various drawings indicate like elements.

DETAILED DESCRIPTION

This invention relates to a system of pre-manufactured concrete modules that can serve as a freestanding school classroom, expand a preexisting school, apartment units, small office of other commercial space. Construction details permit the option of readily adding exterior facades such as brick, stucco, stone or lapboard, for example, to architecturally blend the new structure with the existing structure. Individual modules can be connected horizontally and/or vertically stacked to form multi-story structures. The room sizes may vary as to need and desire so that the rooms can be versatile and the only thing that will be required is that the room sizes can be engineered economically and safely. The modules forming the building structure can be constructed to withstand hurricanes, rainstorms, windstorms, snowstorms, and if geographic conditions warrant, seismic activity.

For classroom applications, the modules can readily provide additional student capacity when demographic changes require it. The modules can be attached to and integrated with the existing school and not an isolated "portable" style classroom. The modules can be delivered to the construction site and furnished with interior features, desks, chalkboards. The modules can be located to form hallways and bathrooms, for example. In commercial applications, the modules can be arranged in various horizontal and vertical configurations to meet the particular building requirements.

With reference now to the drawings and more particularly to FIG. 1, there is shown a concrete building module 20 according to the invention. The module 20 can be pre-manufactured in a factory to desired specification and include all building facilities, such as bathrooms, closets, hallways, interior wall furnishings, and lighting fixtures, for example, and ready for use after placement and installation at the construction site. Alternatively, if practical, the module can be cast onsite. The module 20 is a single story building having a generally rectangular floor plan and is formed from steel reinforced concrete floor member 22, wall members 24 and roof member 26. Other floor plan dimensions are contemplated to meet individual building requirements. The floor, wall, and roof member 22, 24, 26 can be formed from reinforced concrete slab having a thickness of six inches. In one embodiment, the roof member 26 extends beyond an exterior wall member 24 in one direction to form an overhang 28. The concrete roof member 26 can be coated with a waterproof layer or membrane, such as a thoroseal material, for example. The roof member 26 can also be flat or pitched along the lateral dimension of the module 20 at a suitable pitch, such as 1/4-inch per foot for improved drainage.

The module 20 can also include preinstalled windows 30 and doors 32. Cutouts 34 in wall members 24 adjacent the roof members 26 form conduits for continuous piping 36 from one module 20 to another adjacent module, comparable to module 20, or to a preexisting building. The floor, wall, and roof members 22, 24, 26 are cast individually in appropriately sized forms and then joined together as described below. The interior surfaces of the wall members 24 can be covered with drywall or painted plywood. Optional facings 38 can be attached to the exterior surfaces of the wall members 24, such as brick, stone, stucco, or lapboard for example, to conform the building module 20 to the preexisting building to which it can be attached.

Referring to FIG. 2, the modules 20 can be stacked to form the two-story structure 40 as shown. Up to the three modules can be stacked vertically. The modules can also be attached horizontally (not shown), to form a larger, single-story structure. Junctions (discussed below) disposed between adjacent members of the modules 20 connect the first and second modules together. The structure 40 is supported by concrete pilings 42 or concrete footings spaced along the underside of the floor member 22 of the first-story module. Along the mating surfaces

between the modules, filler strips 44 consisting of elongate decorative metal or plastic panels, can be attached.

The structure 40 can serve as a standalone classroom, with interior facilities including blackboards/whiteboards, clocks, closets and cabinetry and desks, for example. As shown in FIGS. 3 and 4, the structure 40 can function as an addition to an existing school building. Preferably, the structure 40 is attached to the existing school building and integrated into the design of the school. FIG. 3 depicts an aggregation of structures 40 to form a wing 41 extending from an existing building 43. In this example, the wing 41 includes two sets of two structures 40a, 40b, 40c and 40d, connected by a hallway section 45 spanning the adjacent units. The wing 41 is attached to the building 43 by vestibules 47 extending therebetween. As shown in FIG. 4, floor member 49 extends from a first structure 40a to a second structure 40c, 40d. One end of the member 49 bears on notch unit 51. A roof extension member 53 spans the roof members of structures 40a and 40c. In one example, the roof is arcuate and includes a skylight (shown in phantom). Alternatively, the structure 40 is located proximate to the school for ready accessibility. In the classroom application, the structure 40 can also be assembled and installed on site to meet the needs of increased enrollment at a particular school and later, if enrollment drops, detached and reinstalled for use in a different school district. The structure 40 can also serve individually or collectively, as apartment units, office space, or commercial retail space.

A representative floor plan shown in FIG. 5, shows exterior dimensions of about 20 by 30 feet. Although the floor plan shown is rectangular, other dimensions, as dictated by the site, the specifications, and the existing structure (if an expansion), are contemplated. The floor member 22 is formed from one or more slabs of reinforced concrete, similar to roof member 26, with a thickness of six inches. Flat beams 46 extend beneath the floor member 26 to support the module 20 on pilings and/or footings 42 (FIG. 2). Interior spaces such as closets 50 are formed with internal, non-load bearing walls 52, framed with metal or wood studs, having a thickness of six inches.

As shown in FIG. 6, steel rods 52 extend vertically between upper and lower horizontal steel beams 52, 54, respectively, for reinforcing the wall member 24. The module 20 is

supported by pilings 42 positioned along the span of floor member 22 and corresponding to the flat beams 46 (FIG. 5). The ceiling height is nominally 9 feet.

Referring now to FIG. 7, the floor, wall, and ceiling members 22, 24, 26 are joined together along wall-to-roof member junctions 60, wall-to-single floor member junctions 62, wall-to-two floor member junctions 64, a and floor-to-floor junctions 66. The wall and roof members in junction 60, the wall and floor members in junction 62, and the wall and floor members in junction 64 are separated a vertical gap or distance D_1. This distance is filled by a compliant pad 70 disposed between the concrete members. The pad 70 can be formed from a commercial available synthetic rubber compound, such as neoprene. A sealant 72 is applied along the peripheral edges of the pad 70 to substantially seal the connection against infiltration of weather and debris. Adjacent floor members 22 at junctions 64 and 66 are separated by a horizontal gap of distance D_2 filled with sealant 72 to bridge the gap. The vertical and horizontal gaps defined by D_1 and D_2, respectively, in junctions 60, 62, 64, and 66, spanned by pad 70 or filled with sealant 72, permit relative movement between wall, floor, and roof members during transport and after installed at the site to accommodate building settling, while also mitigated cracking and other damage to concrete members 22, 24, and 26 of the structure 40 (FIG. 2).

FIGS. 8, 9, and 10 show the junctions 60, 62, 64 and 66 in greater detail. Generally the detailed view of a typical joint, depicted in FIG. 11, shows the ends of adjacent floor members 22 positioned proximate one another and separated by a horizontal gap of distance D_2 filled with sealant 72. A compliant pad 70 is interposed between the wall member 24 and the two floor members 22, spanning the vertical distance D_1. A layer of sealant 72 also extends along the periphery of the compliant pad 70 to substantially seal the connection against infiltration of weather and debris. Reinforcing steel rebar 52 extends vertically through the wall members 24 to strengthen the wall members in tension, as is commonly known in the art. For those areas of steel rebar 52 which are exposed, a layer of anticorrosive paint can be applied to resist oxidation of the rebar. A channeled layer 78 is attached to the lower surface of the floor members 22. The channeled layer 78 can include metal decking for supporting ceiling fixtures, containing insulation or concealing pipes and ventilation components, for example. A second complaint pad

80, spanning a vertical distance D_3, is disposed between the channeled layer 78 and the flat beam 24.

The compliant pads 70, 80 can be made from commercially available synthetic rubbers, such as neoprene, for example. Collectively, pad 70, extending along the distance D_1, second pad 80 extending between the layer 78 and the flat beam 24, and horizontal gap of distance D_2, filled with sealant 72, prevent direct contact between the wall and floor members 22, 24, which accommodates relative moment therebetween for transport and settling while still maintaining sufficient dimensional stability and rigidity of the structure. Referring to FIG. 10, the wall section 24 is supported by piling 42. The flat metal beam 46 is rigidly connected to the concrete pile 42 (or footing) beneath it, by a steel strap 82, for example.

FIG. 12 shows a typical window section. A window 100, bounded by a window frame 102, is installed within corresponding open of wall member 24, according to standard, accepted installation techniques. A concrete teat 104 or 1-inch pressure-treated wood beam is positioned along the top of the window 100. About all sides, the window frame 102 is secured in place with screws fastened to lead shields 106 which are attached to the opening in the wall member 24. Pressure treated wood trim 108 and window sealant 110 are attached along the outside perimeter of the opening in the wall section 24 along the window 100 . The decorative façade 38, attached to the exterior surface of the wall member 34 can extend proximate the lowest edge of the window 100 to form a window sill 112. The sill 112 can be pitched downward away from the window 100 to facilitate drainage of rain water. An interior wall 114, attached to the inside surface of the wall member 24, can be 5/8-inch drywall or painted plywood 112, for example.

FIG. 13 shows a detailed view of the lower edge of door 32. The door can be solid wood, fiber glass-composite heavy-gauge, galvanized steel over a core of rigid foam, for example. If the doors 32 open to the outside, an exterior door sill 118 extends from the floor member 22 to engage the lower edge of the door 32 and provide a tight seal. Folding stairs 120 can be attached to the inside of the door 32 for emergency egress from the structure 40. The stairs 120 can include a rope 122, attached to the stairs, for extending the stair 120 away from the door 32.

A number of embodiments have been described herein. Other embodiments are within the scope of the following claims.